

We claim:

1. A wind tunnel for use in testing a vehicle comprising:
a housing having at least one air inlet and at least one air outlet;
5 at least one air mover adapted to create a flow of air through the housing in a first direction from the air inlet toward the air outlet;
a vehicle support positioned at least partially within the housing and which has an inclined support surface which is angled with respect to horizontal and is operable to support the vehicle such that the vehicle is biased toward movement in the first
10 direction; and
a force measurer coupled to the vehicle and operable to measure the force resulting from the impact of moving air against the vehicle.
2. A wind tunnel according to claim 1 in which the angle of incline
15 of the inclined support surface is adjustable.
3. A wind tunnel according to claim 1 in which the vehicle support comprises at least one inclined ramp.
- 20 4. A wind tunnel according to claim 1 in which the housing has a floor and the inclined support surface comprises a portion of the floor of the housing.
5. A wind tunnel according to claim 1 in which the incline of the inclined support is from about one degree to about five degrees.
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6. A wind tunnel according to claim 1 in which the incline of the inclined support surface is established at a magnitude to compensate for static friction that must be overcome for a wheeled vehicle to commence movement.

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7. A wind tunnel according to claim 1 in which the incline of the inclined support surface is established at a level such that the force measurer indicates a substantially zero force measurement in the absence of moving air impacting the vehicle.

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8. A wind tunnel according to claim 1 in which the air mover comprises at least one fan.

9. A wind tunnel according to claim 1 in which the force measurer
10 comprises at least one load cell positioned to engage the vehicle.

10. A wind tunnel according to claim 1 in which the housing comprises a plurality of air outlets and the air mover comprises a plurality of fans coupled to the air outlets for moving air through the housing.

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11. A wind tunnel according to claim 1 in which the vehicle is a truck or truck tractor with a pseudo-trailer, the pseudo-trailer having a front surface, the cross-sectional dimension of the air outlet of the housing which is unblocked by the truck or truck tractor and pseudo-trailer being approximately the same as the cross-sectional
20 dimension of air inlet of the housing.

12. A wind tunnel for use in testing a vehicle comprising:
a housing having at least one air inlet and at least one air outlet;
at least one air mover adapted to create a flow of air through the housing in a
25 first direction from the air inlet toward the air outlet;
a plurality of ramps positioned to support the wheels of a vehicle being tested on respective inclined surfaces of the ramps to bias the vehicle to roll in the first direction;
and

a force measurer coupled to the vehicle and operable to measure the force resulting from the impact of moving air against the vehicle.

13. A wind tunnel according to claim 12 in which the inclined surfaces are
5 each inclined at the same angle.

14. A wind tunnel comprising:
a test section for receiving a vehicle, the test section comprising a first end
portion, a second end portion and an inclined vehicle support;
10 at least one air flow generator for creating air flow through the test section in a
direction from the first end portion to the second end portion; and
a force measurer for measuring the force applied by the moving air to the
vehicle.

15 15. The wind tunnel of claim 14 in which the force measurer is disposed
proximate the second end portion for engaging the vehicle to measure the force.

16. The wind tunnel of claim 14 wherein the force measurer comprises a
load cell.
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17. The wind tunnel of claim 14 further comprising a plurality of air flow
generators for creating air flow through the test section, each air flow generator
comprising an air flow inlet and an air flow outlet, the wind tunnel further comprising a
plurality of air flow ducts, each of which has a first end in direct communication with
25 the second end portion of the test section and a second end in communication with the
air flow inlet of at least a respective one of said air flow generators.

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18. The wind tunnel of claim 17 further comprising a plurality of diffusers, each diffuser comprising a diffuser inlet in communication with the air flow outlet of one of said air flow generators.

5 19. The wind tunnel of claim 18 further comprising a contraction cone having a contraction cone air inlet and a contraction cone air outlet in communication with the first end portion of the test section.

10 20. The wind tunnel of claim 14 wherein the at least one air flow generator is a fan.

21. The wind tunnel of claim 17 wherein there are at least eight of said air flow generators.

15 22. The wind tunnel of claim 18 wherein the air flow ducts are arranged with their first ends in a generally horseshoe configuration.

20 23. A wind tunnel comprising:
a test section having an air inlet and an air outlet; and
a plurality of air ducts, each air duct comprising at least one duct inlet and at least one duct outlet, the duct inlets being positioned at the air outlet of the test section; and
a plurality of air flow movers, each air flow mover comprising a mover inlet and a mover outlet, the mover inlets of the air flow movers each being coupled to a
25 respective at least one duct outlet of at least one of the said air ducts.

24. The wind tunnel of claim 23 wherein the air ducts are arranged to define at least a portion of a chamber in which a rear portion of a vehicle may be positioned with the remaining portion of the vehicle being positioned in the test section.

25. The wind tunnel of claim 23 wherein there is a separate individual air mover for each of said ducts.

5 26. The wind tunnel of claim 24 further comprising a plurality of diffusers, each diffuser comprising a diffuser inlet coupled to a respective at least one mover outlet of one of said air flow movers.

10 27 The wind tunnel of claim 25 wherein there is a separate individual diffuser coupled to each air mover.

28. The wind tunnel of claim 27 further comprising a contraction cone having a contraction cone outlet coupled to the air inlet of the test section.

15 29. The wind tunnel of claim 23 wherein the air ducts are positioned at least along the sides and across the top of the test section air outlet.

30. A wind tunnel for generating air flow over a surface of a vehicle, the wind tunnel comprising:

20 a test section having a forward end portion, a rear end portion, and a length extending therebetween; the test section having an air outlet adjacent to the rear end portion; and

a plurality of air ducts, each having a duct inlet and a duct outlet, the duct inlet of each air duct being coupled to the air outlet of the test section, the air ducts being
25 arranged to position the duct inlets in a generally horseshoe shaped configuration; and at least one air mover operable to move air through the test section and air ducts.

31. The wind tunnel of claim 30 comprising an inclined vehicle support.

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32. The wind tunnel of claim 31 wherein the vehicle has wheels and the included vehicle support comprises a plurality of vehicle wheel supporting ramps.

33. A wind tunnel test section comprising a first end portion, a second end
5 portion, and a vehicle support comprising at least one inclined support surface positioned to support the vehicle.

34. The wind tunnel test section of claim 33 wherein the angle of the slope of the inclined support surface is sufficient to overcome the static wheel bearing and tire
10 friction of a vehicle to be tested in the wind tunnel test section.

35. The wind tunnel test section of claim 33 in which the inclined support surface comprises an inclined surface of a plurality of ramps at least one such ramp supporting each of the wheels of the vehicle.
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36. A wind tunnel for generating air flow over a surface of a vehicle which is a truck or truck tractor of the type used to tow a trailer, the wind tunnel comprising:
a test section having a forward end portion, a rear end portion, and a length extending therebetween, the test section having a vehicle support that slopes downward
20 at an angle of incline which is sufficient to overcome the static tire and wheel bearing friction of the vehicle being tested;

a plurality of air ducts, each duct comprising a duct inlet and a duct outlet, the duct inlet of each air duct being directly coupled to the air outlet of the test section and the air ducts being arranged such that the duct inlets are in a generally horseshoe shaped
25 configuration;

a plurality of air flow movers, each air flow mover comprising an air mover inlet and an air mover outlet, each air mover inlet being coupled to a respective one of the duct outlets, each air mover comprising a fan for moving air through the air mover and thereby through the test section;

a plurality of diffusers, each air diffuser comprising a diffuser inlet coupled to the air mover outlet of a respective one of said air movers and a diffuser outlet in communication with the atmosphere; and

a contraction cone having a contraction cone air inlet in communication with the
5 atmosphere and a contraction cone air outlet coupled to the forward end portion of the
test section.

37. A wind tunnel for use in testing a vehicle comprising:

housing means for receiving the vehicle to be tested, the housing means having a
10 front end portion and a rear end portion;

vehicle support means for supporting the vehicle or vehicle wheels at an angle;

duct means coupled to the rear end portion of the housing means for directing air from the housing means;

air mover means for moving air through the duct means and thereby through the
15 housing means; and

force measurement means coupled to the vehicle being tested for measuring the force of air moving against a vehicle in the housing means.

38. A wind tunnel according to claim 37 comprising a contraction cone means
20 coupled to the housing front end portion and air diffuser means coupled to the air mover
means.

39. A method of testing the aerodynamics of a vehicle comprising;
supporting a vehicle or vehicle wheels in a wind tunnel at an angle of incline;
25 directing air toward the vehicle; and
measuring the load exerted by the inclined vehicle in response to air moving
against the vehicle.

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40. A method according to claim 39 in which each of the wheels is separately supported on a respective inclined surface.

41. A method according to claim 40 in which each of the wheels is
5 supported at the same angle of incline.

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